

The Lichens of Norfolk Island

1: Introduction and the Family Parmeliaceae

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ELIX, J. A., & STREIMANN, H. The lichens of Norfolk Island. 1: Introduction and the family Parmeliaceae. *Proc. Linn. Soc. N.S.W.* 111 (2), 1989: 103-121.

The historical records of lichens of the Norfolk Island complex are discussed and synonymy given. The 16 species (from 7 genera) of the Parmeliaceae which currently grow there are examined critically. Each species is described fully (including chemistry) and its distribution is recorded. The endemic *Flavoparmelia norfolkensis* Elix & Streim. is described as new to science. All 16 species on these geologically recent, oceanic islands possessed vegetative dispores, attesting to the efficiency of this method of reproduction.

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KEY WORDS *Flavoparmelia norfolkensis* Elix & Streim., *Neofuscelia verrucella* (Essl.) Essl., *Paraparmelia scotophylla* (Kurok.) Elix & Johnston, *Parmelia erumpens* Kurok., *Parmelinopsis spumosa* (Asahina) Elix & Hale, *Parmotrema austrocetratum* Elix & Johnston, *Parmotrema chinense* (Osbeck) Hale & Ahti, *Parmotrema crinitum* (Ach.) Choisy, *Parmotrema cristiferum* (Taylor) Hale, *Parmotrema gardneri* (Dodge) Sérusiaux, *Parmotrema rampoddense* (Nyl.) Hale, *Parmotrema reticulatum* (Taylor) Choisy, *Parmotrema sancti-angelii* (Lyngé) Hale, *Parmotrema tinctorum* (Despr. ex Nyl.) Hale, *Xanthoparmelia amplexula* (Stirton) Elix & Johnston, *Xanthoparmelia australasica* D. Gall., Parmeliaceae, chemotaxonomy, Norfolk Island, lichens.

INTRODUCTION

The Norfolk Island complex (including Norfolk, Phillip and Nepean Islands with the satellite islands) is an isolated volcanic outcrop in the South Pacific Ocean between longitudes 167°55' and 168°00' E and latitudes 28°59' and 29°08' S. The islands lie on a narrow, steep-sided submarine ridge (the Norfolk Ridge) which extends from New Caledonia to New Zealand (Jones and McDougall, 1973). The closest land is New Caledonia, 670 kilometres to the north. Norfolk Island lies approximately 1610 kilometres north-east of Sydney and 1100 kilometres north-north-west of Auckland (Fig. 1).

The islands are an Australian territory: Norfolk Island (the largest) is 8 kilometres long and 6 kilometres wide; Phillip Island is 2 kilometres long and 1 kilometre wide, while Nepean Island is approximately 500 metres long and 300 metres wide (Figure 2).

Norfolk and Phillip Islands have similar geology: both are almost completely volcanic in origin. Olivine basalt lavas predominate on Norfolk Island, with basaltic tuffs relatively more common on Phillip Island. This volcanic activity occurred 2.3-3.2 million years ago, during the Pliocene epoch (Jones and McDougall, 1973). Nepean Island and part of Norfolk Island (near Kingston) consist of coarse marine calcareous rock of late Pleistocene origin (Ovington, 1984).

The highest point on Norfolk Island is Mt Bates, which is 319 metres above sea level. Mt Pitt is slightly lower (318m), but these peaks are only 600 metres apart and together form the summit complex. The southern half and north-west corner of the island are gullied plateaux 90-120 metres a.s.l. and are distinct from the Mt Pitt — Mt Bates summit area. Most of the coastline, except for a length on the southern coast (Kingston area) and several bays, consists of cliffs up to 140m high (Jones and McDougall, 1973; Ovington, 1984).



Fig. 1. Location of Norfolk Island.

Phillip Island is even more rugged and precipitous, rising to its highest point at Jacky Jacky (280 metres a.s.l.) and surrounded by coastal cliffs. Largely defoliated by feral rabbits, pigs and goats, the island is eroded extensively, with many exposed boulders and rock outcrops. The plateau above the coastal cliffs consists of a series of eroded valleys which rise towards the summit, where the slope ends abruptly at a near-vertical cliff, 280 metres a.s.l. (Coyne, 1982). Nepean Island, an uninhabited limestone island a few acres in extent, rises to 32 metres (Hoare, 1965).

The climate of Norfolk Island is sub-tropical with no extremes of temperature and moderate relative humidity (72-81%) with no seasonal pattern. Mean monthly temperature fluctuates from minima near 12°C (in winter) to maxima near 25°C (in summer) and the daily range is rarely more than 8°C. Rainfall (mean annual precipitation 1313mm) occurs throughout the year with a winter maximum (June average of 163mm). Droughts of some weeks duration may occur (Ovington, 1984).

HISTORY OF LICHENOLOGICAL INVESTIGATIONS

Captain James Cook discovered Norfolk Island on October 10, 1774, during his second voyage around the world. The following day he landed at Duncombe Bay and named the island after the then Duchess of Norfolk. Although uninhabited at the time, Polynesian stone adzes have been discovered since, suggesting earlier settlement. Fourteen years after discovery, the first of two penal settlements was established and maintained until 1814. A second penal settlement was established in 1826 and abandoned 30 years later. In 1856, descendants of the 'Bounty' mutineers left their home on Pitcairn Island and established the first free settlement on Norfolk, and today the 'Islanders' still comprise some 30% of the total population of approximately 2,000 (Hoare, 1965).

Norfolk Island has been visited by a number of scientific expeditions in the course of its short history. Few of the early expeditions contributed greatly to the lichen flora.

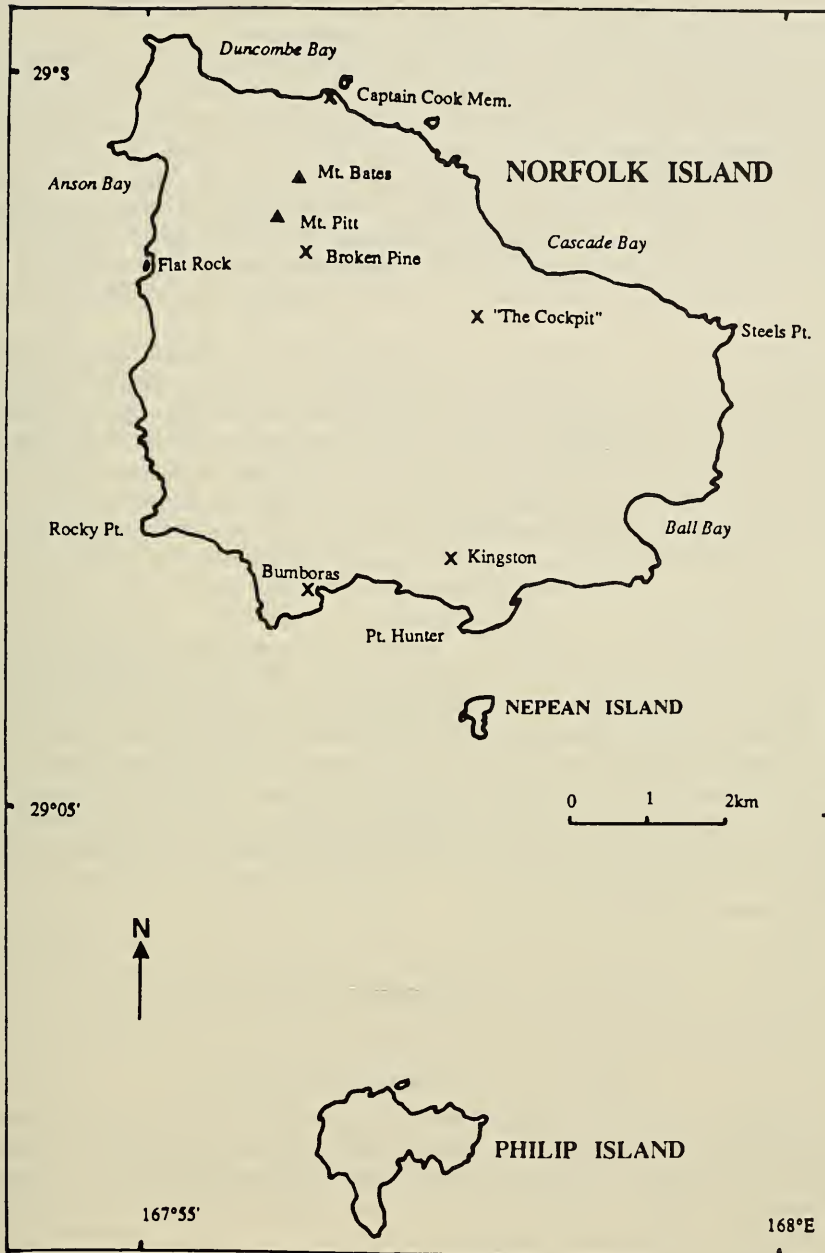


Fig. 2. Map of the Norfolk Island complex. Here, and on Fig. 3, 'Philip Island' should be Phillip Island.

In 1804-5 Ferdinand Bauer visited the island and his collections and drawings were submitted to Stephan Endlicher of Vienna, who published a *Prodromus* (Endlicher, 1833) to the plants which listed four lichens: *Evernia* (*Usnea*) *melaxantha* Ach., *Parmelia* (*Parmotrema*) *perlata* Ach., *Parmelia* (*Physcia*) *caesia* Ach., and *Sticta* (*Pseudocyphellaria*) *aurata* Ach.

In 1830 Allan Cunningham visited the island and augmented the knowledge of its

botany; his notes were published posthumously in Heward (1842). A lichen not enumerated by Endlicher was listed, namely *Ramalina scopulorum* Ach.

Baron Ferdinand von Mueller subsequently investigated the botany of the island on the basis of specimens collected by Isaac Robinson, a resident and agent for the Sydney Botanic Gardens. The identity of the lichen collections was communicated subsequently to J. H. Maiden (see below).

In 1904 J. H. Maiden (Director of the Botanic Gardens in Sydney) reported a total of 29 lichen species for Norfolk Island. This list was prepared by Edwin Cheel (Botanic Gardens, Sydney) after examining the collections of Maiden and Boorman (made during a visit to the island in 1902), and was supplemented by F. von Mueller (Melbourne), who supplied the names of six species identified by J. Müller of Aargau, Switzerland.

This list is presented here using currently-accepted names for taxa (bold) followed, where appropriate, by the synonyms used by Maiden in brackets. [?] infers a dubious identification — according to Maiden. The species list included: *Anaptychia ciliaris* (L.) Körb. [?]; *Catinaria grossa* (Pers. ex Nyl.) Vainio {*Patellaria grossa* Müll. Arg.}; *Catinaria versicolor* (Fée) Sipman {*Patellaria versicolor* Fée}; *Chiodecton perplexum* Nyl.; *Clathroporina eminentior* Nyl.; *Coenogonium implexum* Nyl.; *Dirinaria confluens* (Fr.) Awasthi {*Physcia confluens* Mitt.}; *Glyphis verruculosa* Zahlbr. {*Glyphis verrucosa* Knight}; *Leptogium cyanescens* (Rabenh.) Körb {*L. tremelloides* L.}; *Letrouitia bifera* (Nyl.) Hafelln. {*Heterothecium biflorum* Nyl.}; *Ochrolechia pallescens* (L.) Massal. {*Lecanora pallescens* Fr.} [?]; *Parmentaria ravenellii* (Tuck.) Müll. Arg. {*Parmentaria havenlii* Tuck.} [?]; *Parmotrema chinense* (Osbeck) Hale & Ahti [*Parmelia perlatus* L.]; *Pertusaria* sp.; *Phyllopsora parvifolia* (Pers.) Müll. Arg. {*Psora parvifolia* Müll. Arg.}; *Physcia caesia* (Hoffm.) Fűrnr.; *Physma byrsinum* (Ach.) Müll. Arg.; *Pseudocyphellaria aurata* (Ach.) Vainio {*Sticta aurata* Ach.}; *Pyrenula nitida* (Weigel) Ach. [?]; *Pyxine cocoes* (Sw.) Nyl.; *Ramalina farinacea* (L.) Ach.; *Ramalina glaucescens* Krempelh. {*R. leiodea* Nyl. var. *fastigiata* Müll. Arg.}; *Ramalina siliquosa* (Huds.) A.L. Sm. {*R. scopulorum* Ach.} [?]; *Ramalina thrausta* (Ach.) Nyl. {*R. thrausta* (Ach.) Fr.} [?]; *Teloschistes flavicans* (Sw.) Norm.; *Usnea aurantiaco-atra* (Jacq.) Bory {*Evernia melaxantha* Ach.} [?]; *Usnea barbata* (L.) Weber ex Wigg. {*U. barbata* Ach.}; *Usnea florida* (L.) Weber ex Wigg. {*U. barbata* Ach. var. *florida* (L.) Fr.}; *Usnea intercalaris* Krempelh.

Since then only scattered individual reports of lichens occurring in Norfolk Island have appeared in the literature, such as that of *Usnea nexilis* Motyka and *U. propinqua* Stirton (Motyka, 1938), *Ramalina arabum* (Dill. ex Ach.) Meyen & Flot. (Riedl, 1976) and from preliminary reports of the present work (Elix and Streimann, 1985).

PRINCIPAL VEGETATION FORMATIONS

The vegetation of the Norfolk Island complex was divided into five major formations: sub-tropical rainforest, open *Araucaria* woodland, pastures and foreshores, weedy forests dominated by *Psidium* and *Olea*, and Phillip Island (Elix and Streimann, 1985; Ovington, 1984). Brief notes are given below for these, together with the dominant lichen genera occurring in each formation.

Sub-tropical Rainforest

No doubt the Mt Pitt Reserve, with its remaining areas of sub-tropical rainforest, is the major habitat for lichens on the island and has the richest lichen flora. Dominant spermatophytes including *Araucaria heterophylla* together with varying amounts of native hardwoods — *Elaeodendron cirtipendulum*, *Nestegis apetala*, *Rapanea crassifolia* and *Baloghia lucida*. The understorey comprises smaller trees and sometimes scattered palms (*Rhopalostylis baueri*), tree ferns (*Cyathea* spp.) and the exotics red guava, *Psidium littorale*

and *Citrus limon*. Within this reserve, the eastern and south-eastern slopes of Mt Bates appear to be the richest site for lichens. Corticolous species abound: the richest substrates are the trunks of *Elaeodendron* and the base of the trunks and branches of *Araucaria heterophylla* and *Citrus limon*. The macrolichen genera *Heterodermia*, *Parmotrema*, *Ramalina*, *Teloschistes* and *Usnea* are prominent in the canopy while *Coccocarpia*, *Pannaria*, *Physma* and *Pseudocyphellaria* species occur in the wetter areas at the base of trees. *Elaeodendron curtispiculum* is by far the richest substrate for crustose lichens, including many species of Graphidaceae, *Pyrenula* and extensive cover by *Clathroporina* and *Megalospora*. One of the most conspicuous lichens of the forest is the beautiful *Pseudocyphellaria aurata*, with its brilliant yellow and emerald green (when wet) thallus, which commonly inhabits the trunks of *Cyathea*, *Citrus* and *Araucaria*.

Open *Araucaria* Woodland

Open *Araucaria* woodlands, which occur at sites such as Anson Bay Reserve, Selwyn Recreation Reserve and Ball Bay Reserve, constitute the second most important lichen habitat on the island. The *Araucaria* trees throughout the island are characterized by a prodigious growth of *Ramalina arabum* and *Usnea* sp. on the canopy branches in particular, as well as on lower branches. *Dirinaria*, *Pyxine* and *Physcia* species as well as various *Ramalinae*, are very abundant and well developed on the branches of most *Araucaria* trees, while *Xanthoria* and *Caloplaca* species are limited to *Araucaria* in coastal situations.

Pastures and Foreshores

Here old fence posts are colonized by a few corticolous lichens (*Usnea*, *Ramalina*, *Lecanora* sp.). Remnant *Araucaria* trees which occur in scattered stands or as individuals are much better substrates, with more species present and larger populations of lichens. However their communities are impoverished compared with those on woodland or forest trees of similar age. Exposed rock surfaces in pasture and along the foreshores are more interesting substrates. Their communities include representatives of *Neofuscelia*, *Paraparmelia*, *Parmotrema* and *Xanthoparmelia* plus a variety of microlichen genera including *Diploschistes*, *Lecanora* s.l. and *Lecidea* s.l. Interestingly the limestone outcrops near Emily Bay provide a suitable habitat for several calciphilic species, including a very unusual *Buellia*.

Weedy Forest dominated by *Psidium littorale* and *Olea africans*

Areas of Mt Pitt Reserve dominated by thickets of *Psidium littorale* (guava) are extremely poor in lichens. *Psidium* supports no lichens and its dense canopy prevents growth on soil or other small trees and shrubs. Lichens in these areas are found virtually only on scattered remnant *Araucaria* or other native trees. *Olea africans* dominates other drier areas on the Reserve and, like *Psidium*, it is a very poor lichen host. Only scattered depauperate *Usnea*, *Ramalina* and *Parmotrema* species are found on *Olea* in such areas.

Phillip Island

The Phillip Island lichen flora is rather depauperate because of the rarity of host trees. The branches of remnant *Lagunaria patersonia* are moderately well covered with lichens, but are relatively poor in taxa, mainly species of *Dirinaria*, *Physcia* and *Pyxine*. However saxicolous lichens are quite well developed in some areas of Phillip Island (e.g. upper Long Valley), although again the number of species is not large, with *Parmotrema reticulatum* being particularly common. Oddities include *Teloschistes flavicans* growing on soil and rocks, usually a corticolous species, and *Xanthoria*, *Caloplaca* and *Lecidea* growing on consolidated soil, imitating the soil crust lichens of arid inland Australia.

THE LICHEN FAMILY PARMELIACEAE

Representatives of the genera *Flavoparmelia*, *Neofuscelia*, *Paraparmelia*, *Parmelia*, *Parmelinopsis*, *Parmotrema* and *Xanthoparmelia* are detailed and a key to the species is given. A full description of each species (including chemical constituents) and its distribution are provided. Interestingly all (16) species have vegetative diaspores, illustrating the ease of dispersal of such units in reaching such isolated oceanic islands, and hence the effectiveness of such a mode of reproduction.

Artificial Key to the Parmeliaceae in Norfolk Island

1. Thallus brown *Neofuscelia verrucella*
1. Thallus grey or yellow-green 2
2. Thallus yellow-green 3
2. Thallus grey 5
3. Thallus with a pale lower surface *Xanthoparmelia amplexula*
3. Thallus with a black lower surface 4
4. Thallus with cylindrical isidia, medulla white
throughout *Xanthoparmelia australasica*
4. Thallus with pustulate isidia, lower medulla
yellow-orange *Flavoparmelia norfolkensis*
5. Lobes narrow, less than 1.5mm broad 6
5. Lobes broad, greater than 2mm broad 7
6. Thallus isidiate, saxicolous *Paraparmelia scotophylla*
6. Thallus pustulate, usually corticolous *Parmelinopsis spumosa*
7. Upper surface pseudocyphellate *Parmelia erumpens*
7. Upper surface lacking pseudocyphellae 8
8. Thallus isidiate or sorediate 9
8. Thallus lacking soredia or isidia, but with flaking upper
cortex *Parmotrema austrocetratum*
9. Thallus isidiate 10
9. Thallus sorediate 11
10. Thallus ciliate, medulla K+ yellow, C- *Parmotrema crinitum*
10. Thallus eciliate, medulla K-, C+ red *Parmotrema tinctorum*
11. Upper surface reticulately cracked *Parmotrema reticulatum*
11. Upper surface lacking reticulate cracks 12
12. Medulla K+ yellow or K+ yellow-red 13
12. Medulla K- 14
13. Medulla K+ yellow-red, containing salazinic acid *Parmotrema cristiferum*
13. Medulla K+ yellow, containing stictic acid *Parmotrema chinense*
14. Medulla C+ rose, containing gyrophoric acid *Parmotrema sancti-angelii*
14. Medulla C- 15
15. Thallus ciliate, medulla P-, UV+, containing alecutoronic
acid *Parmotrema rampoddense*
15. Thallus eciliate, medulla P+ brick-red, UV-, containing protocetraric
acid *Parmotrema gardneri*

Specimens Examined

Collectors and location of specimens examined are as follows: *JA*E were collected by *J. A. Elix* and *H. Streimann* and are held in ANUC; *HS* were collected by *H. Streimann* and are held in CBG with duplicates distributed as indicated.

Collection site details (for map see Fig. 3):

S1: open *Araucaria* woodland, Picnic Area, end of Martins Road, 29°03'30"S, 167°59'E, 80m, 1.xii.1984.



Fig. 3. Collection sites on Norfolk Island.

- S2: pasture, Cemetery road, Kingston, 29°03'30"S, 167°58'E, 15m, 2.xii.1984.
- S3: *Araucaria heterophylla*-dominated grassland, Bloody Bridge, Cemetery Road, 29°03'30"S, 167°58'E, 20m, 2.xii.1984.
- S4: mixed exotic and *Araucaria* woodland, Rocky Point Reserve, 29°03'S, 167°55'20"E, 60m, 2.xii.1984.
- S5: mixed sub-tropical rainforest, near Broken Pine, Mt Pitt Reserve, 220-240m, 29°01'30"S, 167°56'20"E, 2.xii.1984.
- S6: stand of *Araucaria heterophylla* along the margin of grassland and forest, Captain Cook Memorial, Duncombe Bay, 29°00'S, 167°56'30"E, 100m, 3.xii.1984.
- S7: regrowth forest, just south of the Captain Cook Memorial, Duncombe Bay, 29°00'20"S, 167°56'30"E, 100m, 3.xii.1984.
- S8: mixed sub-tropical rainforest, Filmy Fern Trail, Mt Pitt Reserve, 29°01'20"S, 167°56'40"E, 130m, 3.xii.1984.
- S9: open woodland with kikuyu grass, Mt Pitt Reserve, track at end of Selwyn Pine Road, 29°01'S, 167°56'30"E, 215m, 3.xii.1984.
- S10: *Olea africans*-dominated valley, Upper Long Valley, Phillip Island, 29°07'30"S, 167°57'E, 80m, 4.xii.1984.
- S11: open *Araucaria* woodland, Point Blackbourne Reserve, end of Two Chimneys Road, 29°03'S, 167°59'E, 3m, 4.xii.1984.
- S12: mixed sub-tropical rainforest, Mt Bates summit trail, Mt Pitt Reserve, 29°00'30"S, 167°56'30"E, 300m, 6.xii.1984.
- S13: mixed sub-tropical rainforest, track from Red Road to Mt Bates, Mt Pitt Reserve, 29°00'40"S, 167°56'40"E, 220m, 6.xii.1984.
- S14: mixed sub-tropical rainforest, King Fern Valley, Mt Pitt Reserve, 29°01'S, 167°56'20"E, 260m, 7.xii.1984.
- S15: grassland with scattered *Araucaria heterophylla*, Flat Rock Bay Picnic Area, Anson Bay Road, 29°01'30"S, 167°55'E, 40m, 7.xii.1984.
- S16: *Psidium*- and *Olea*-infested lowland forest, track at end of Selwyn Pine Road, 29°01'S, 167°56'30"E, 200m, 8.xii.1984.
- S17: rocky foreshore, Ball Bay Reserve, 29°03'S, 167°59'E, 2m, 8.xii.1984.
- S18: rocky cliffs at north-west point, Duncombe Bay, 29°00'S, 167°55'30"E, 50m, 9.xii.1984.
- S19: grassland with scattered *Araucaria heterophylla*, near Jacobs Rock, Anson Bay Road, 29°01'S, 167°55'E, 50m, 9.xii.1984.
- S20: *Araucaria*-dominated grassland, Bumboras Reserve, 29°03'30"S, 167°56'20"E, 10m, 9.xii.1984.
- S21: open pasture, 'The Cockpit', Cascade Creek Valley, 29°01'S, 167°58'E, 35m, 9.xii.1984.
- S22: open woodland, Prince Philip Drive, 29°01'S, 167°58'E, 35m, 9.xii.1984.
- S23: open pasture, Kingston, 29°03'30"S, 167°57'30"E, 8m, 9.xii.1984.
- S24: regrowth rainforest, Mt Pitt Reserve, just south of summit of Mt Pitt, 29°01'S, 167°56'E, 230m, 10.xii.1984.
- S25: mixed sub-tropical rainforest, Bird Rock Track, Mt Pitt Reserve, 29°00'30"S, 167°57'E, 210m, 10.xii.1984.

FLAVOPARMELIA Hale

Flavoparmelia norfolkensis Elix & Streim. sp. nov. (Fig. 4)

Species cum thallo ut in *Flavoparmelia euplecta* sed ad hac specie isidiis cylindricis, coralloideis demum inflatis, apicibus saepe erumpentibus sed esorediosis differt.

Type: Norfolk Island. On *Elaeodendron* in open woodland in forest clearing, Mt Pitt

Reserve, track at end of Selwyn Pine Road, 29°01'S, 167°56'30"E, 215m, *J. A. Elix 18738* and *H. Streimann*, 8.xii.1984 (CBG-holotype; MEL, US-isotypes).

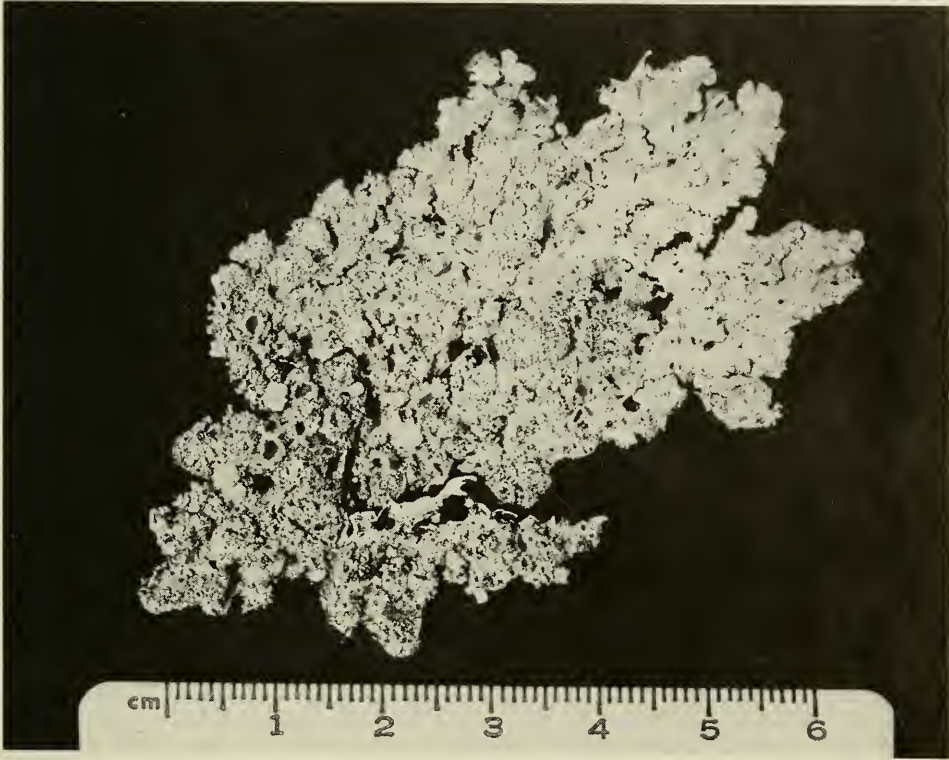


Fig. 4. Holotype of *Flavoparmelia norfolkensis*.

Thallus foliose, corticolous or saxicolous, adnate, pale yellow-green, to 5cm in diameter.

Lobes irregular, 1.0-3.0(-5.0)mm wide, becoming laterally imbricate, \pm contiguous, plane, rotund at the apices. **Upper surface** plane to \pm undulating, dull to slightly shiny, with reticulate, white maculae towards the apices, isidiate; **isidia** laminal, cylindrical at first and becoming coralloid, ultimately becoming inflated at the apices and erumpent-pustulate, hollow within (dactylate), very rarely with traces of granular soredia; medulla white for the most part, but with a yellow-orange zone adjacent to the lower cortex. **Lower surface** black with a very narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. **Apothecia** up to 5mm in diam., disc strongly concave, dark cinnamon brown, dull; margin persistent, strongly inrolled, pustulate-isidiate; spores ellipsoid, $19-21 \times 8-9\mu\text{m}$. **Pycnidia** rare, black, punctiform, immersed; conidia weakly bifusiform, $4-6 \times 1\mu\text{m}$.

Chemistry: Cortex K-; medulla K+ pale brown, C-, P+ brick red; pigmented lower medulla K+ claret; containing usnic acid, protocetraric acid (major), atranorin (\pm trace), euplectin (minor), virensic acid (trace), gyrophoric acid (trace), skyrin (trace).

This species is characterized by the adnate, yellow to yellow-green thallus, the pustulate isidiate upper surface and a medulla pigmented orange (adjacent to the lower cortex) with the anthraquinone, euplectin. In many respects this new species resembles the common Australian species, *F. euplecta* (Stirton) Hale, as both have a similar, pigmented lower cortex and analogous chemistry. However the upper surface of *F. euplecta* is sorediate, with laminal, erumpent-pustulate soralia, which are subcapitate at first but coalesce and spread over the upper surface as granular soredia, whereas *F. norfolkensis* is isidiate with the cylindrical isidia ultimately becoming coralloid, inflating at the apices and bursting open, but remaining esorediate for the most part. This species is quite common throughout the island.

Specimens Examined:

NORFOLK ISLAND. On tree trunk and dead log, S5, *JAE 18333*, 18352; on *Elaeodendron*, S7, *JAE 18379*; on canopy of fallen tree, S8, *JAE 18421*; on *Elaeodendron*, S9, *JAE 18440*; on *Citrus limon*, S12, *JAE 18580*; on fallen *Araucaria heterophylla*, S12, *HS 34354*; on dead treelet branch, S13, *HS 34396*; on *Citrus limon*, S14, *JAE 18669*; on volcanic rocks, S20, *JAE 19269*; on volcanic rocks, S21, *JAE 18787*; on *Citrus limon*, S24, *JAE 18815*; on rock shaded by old building, S23, *HS 34806* (US).

PHILLIP ISLAND. On volcanic rocks with a southerly aspect in the open, S10, *JAE 18501*.

NEOFUSCELIA Esslinger

Neofuscelia verrucella (Essl.) Essl., *Mycotaxon* 7: 53 (1978).

Parmelia verrucella Essl., in C. F. Culberson, W. L. Culberson and T. L. Esslinger, *Bryologist* 80: 132 (1977).

Type: Australia. Victoria: Rock Bore, about 33km NNW of Murrayville, *Dahl* (O-holotype).

Thallus saxicolous, moderately to loosely adnate, yellow-brown to dark brown, 4-6cm in diam. **Lobes** irregular, 1.0-2.5mm wide, often markedly imbricate to entangled. **Upper surface** smooth, shining at margins, wrinkled and cracked in the centre, emaculate, \pm lightly pruinose, moderately to densely isidiate; **isidia** laminal, cylindrical, simple or branched, to 1.5mm tall; medulla white. **Lower surface** black, smooth and shining at margins, matt and wrinkled at centre, sparsely to moderately rhizinate, rhizines simple, black. **Apothecia** rare, to 2mm in diam., sessile, deeply concave when young, becoming \pm flat with age, disc smooth, light to dark-brown, margins entire or sparsely isidiate; spores broadly ellipsoid, 8-9 \times 4-6 μ m. **Pycnidia** not seen.

Chemistry: Cortex K-, HNO₃ + dark blue-green; medulla K-, C-, KC- or KC+ faint rose, P-; containing divaricatic acid (major), nordivaricatic acid (minor).

A common and widespread species in Australia, also occurring in both islands of New Zealand and South Africa. Rare in Norfolk Island.

Specimen Examined:

NORFOLK ISLAND. On volcanic rocks, S21, *JAE 18791*.

PARAPARMELIA Elix & Johnston

Paraparmelia scotophylla (Kurok.) Elix & Johnston, *Mycotaxon* 27: 281 (1986).

Parmelia scotophylla Kurok., in Kurokawa and Filson, *Bull. natn. Sci. Mus. Tokyo* B, 1: 46 (1975).

Type: On rocks, Ardglan Gap, Liverpool Range, 8.5km north of Murrurundi, Great Dividing Range, New South Wales, *S. Kurokawa 5174*, 28.x.1965 (TNS-holotype; MEL-isotype).

Thallus saxicolous, adnate, mineral grey but blackening with age, 5-10 (-20)cm diam. **Lobes** irregular to sublinear, 1.0-3.0mm wide, slightly imbricate, apices subrotund. **Upper surface** smooth, shining at margins, flat to slightly convex, becoming cracked in the centre, emaculate, moderately to sparsely isidiate; **isidia** laminal, cylindrical, simple or sparingly branched, to 0.2mm tall; medulla white. **Lower surface** pale to light brown, sparsely to moderately rhizinate, rhizines simple, concolorous. **Apothecia** rare, to 6mm in diam., substipitate, deeply concave, disc smooth, pale brown, margins thin, involute, isidiate; spores 7-11 x 5-8 μm . **Pycnidia** not seen.

Chemistry: Cortex K+ yellow; medulla K+ yellow then dark red, C-, P+ orange; containing atranorin, salazinic acid (major) and consalazinic acid.

A common and widespread species in Australia, also occurring in both islands of New Zealand. Rare on Norfolk Island.

Specimen Examined:

NORFOLK ISLAND. On volcanic rocks, S21, JAE 18793.

PARMELIA Acharius

Parmelia erumpens Kurok., *Lich. rar. Critic. Exsicc.* no. 74 (1969)

[Based on *Parmelia tenuirima* J. D. Hook. & Taylor f. *corallina* Müll. Arg.]

Parmelia tenuirima J. D. Hook. & Taylor f. *corallina* Müll. Arg., *Flora*, Jena, 66: 46 (1883).

Type: Gippsland, Australia, *Stirling* (G-lectotype; UPS, US-isolectotypes).

Thallus corticolous or saxicolous, adnate to loosely attached, pale greenish to light mineral-grey, 8-20cm in diam. **Lobes** short, subirregular to apically rotund, imbricate, 2-8mm wide. **Upper surface** shiny, plane, white-reticulate at first but becoming conspicuously cracked to the margin, **pseudocyphellae** effigurate, 0.2-1.0mm long, somewhat raised, dense, fusing into a reticulate network over the whole surface, sorediate; the **soredia** coarse and isidioid, often bursting apically, forming dense marginal and laminal soralia and/or extended, granular, coralloid-isidioid outgrowths; medulla white. **Lower surface** black, moderately rhizinate, rhizines simple or squarrosely branched at maturity, 1-2mm long, black. **Apothecia** rare, stipitate, to 15mm in diameter, disc dark brown, concave at first then flattening, margin inrolled at first but splitting radially at maturity, the amphithecium reticulately cracked, pseudocyphellate, sorediate; spores ellipsoid, 10-12 x 6-8 μm . **Pycnidia** scattered, punctiform, black, conidia cylindrical to weakly bifusiform, straight, 5-7 x 1 μm .

Chemistry: Cortex K+ yellow; medulla K+ yellow becoming deep red, C-, P+ red-orange; containing atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (minor), lobaric acid (minor), protocetraric acid (\pm trace).

P. erumpens is a widespread species on rocks and trees in coastal and hinterland areas of Australia, both islands of New Zealand and Lord Howe Island. It also occurs in South Africa, India, Indonesia, Taiwan and Japan. This species is scattered on both rocks and trees in Norfolk Island and is easily recognized by the deeply reticulate-fissured cortex, the abundant coarse, pustular soredia and the lack of cilia. Uncommon in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On exposed volcanic rocks, S2, JAE 18316, HS 31746; on *Elaeodendron*, S5, JAE 18310; on tree, S7, JAE 18360, 18385; on *Elaeodendron*, S16, JAE 18737.

PARMELINOPSIS Elix & Hale

Parmelinopsis spumosa (Asahina) Elix & Hale, *Mycotaxon* 29: 243 (1987).

Parmelina spumosa (Asahina) Hale, *Phytologia* 28: 483 (1974).

Parmelia spumosa Asahina, *J. Jap. Bot.* 26: 259 (1951).

Type: Higashi-Murayama, Kita-Tama-gun, Prov. Masashi, Japan, *Asahina* (TNS-lectotype).

Thallus corticolous, adnate, fragile, pale mineral grey to pale olive grey, 2-6cm in diam. **Lobes** sublinear, narrow, 0.5-2.0mm wide, ciliate, the marginal cilia distinct and evenly dispersed, *ca.* 0.5mm long. **Upper surface** plane, emaculate, continuous, densely pustulate-isidiate; **pustules** laminal, bursting open but sparingly or not sorediate; medulla white or faintly yellow. **Lower surface** smooth, shiny, black, moderately rhizinate, rhizines simple or furcate, short, *ca.* 0.1-0.2mm long. **Apothecia** very rare, laminal, adnate, concave, 1-3mm in diam., disc brown, imperforate, margin and amphitheciium pustulate; spores ellipsoid, 12-14 x 7-8 μ m. **Pycnidia** not seen.

Chemistry: Cortex K+ yellow; medulla K-, C+ rose, KC+ red, P-; containing atranorin, chloroatranorin, gyrophoric acid (major), 5-*O*-methylhiascic acid (minor), umbilicic acid (minor).

P. spumosa is a cosmopolitan species which is widespread throughout the tropical and sub-tropical areas of the world, but is much less common at temperate latitudes. In Australasia it is common in Australia, Papua New Guinea and New Zealand. Exposed trees at the forest margins or isolated individuals are the preferred habitat. Rare in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On *Citrus limon*, S12, *JAE 18584*; on *Elaeodendron*, S22, *JAE 18798*; on *Elaeodendron*, S25, *JAE 18839*, 10.xii.1984.

PARMOTREMA Hale

Parmotrema austrocetratum Elix & Johnston, *Mycotaxon* 31: 495 (1988)

Type: New Zealand. North Island. On tree trunk in remnant forest, Burgess Park, New Plymouth, 60m, *J. A. Elix 4645*, 7.v.1980 (CHR-holotype, CBG-isotype).

Thallus corticolous or saxicolous, loosely attached, light mineral-grey, 6-12cm in diam. **Lobes** rotund, imbricate or not, 10-20(-30)mm wide, apices often laciniate, the lacinae flat or convex, 0.5-1.5mm wide, 1-5(-8)mm long, lobes moderately ciliate, the cilia 0.2-1.0(-1.5)mm long, simple or sparingly branched. **Upper surface** white-reticulate at first but becoming conspicuously cracked to the margin, developing raised closed dactyls, dactyls \pm curved, laminal, ultimately becoming fused and forming laminal ridges, the older parts of the thallus eventually becoming cracked-areolate, with the areolae flaking off and exposing the white medulla in eroded areas; lacking soredia and isidia. **Lower surface** black with a bare, brown marginal zone 1-2mm wide, moderately to densely rhizinate, rhizines simple or sparsely branched, slender, black. **Apothecia** rare, stipitate, to 10mm in diameter, disc perforate, pale tan, concave at first then concave-distorted, margin eciliate, thin, \pm stellate-cracked; spores ellipsoid, 12-16 x 8-9 μ m. **Pycnidia** scattered, punctiform, black, conidia filiform, 9-16 x 1 μ m.

Chemistry: Cortex K+ yellow; medulla K+ yellow becoming deep red, C-, P+ red-orange; containing atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (minor), protocetraric acid (\pm trace).

P. austrocetratum is a widespread species on rocks and trees in coastal and hinterland areas along the sub-tropical and tropical east coast of Australia and the north island of New Zealand. Uncommon in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On *Cyathea* stem, S5, *HS* 31905; on *Elaeodendron*, S8, *JAE* 18439, *HS* 32190 (B, H, US); on *Elaeodendron*, S16, *JAE* 18742.

Parmotrema chinense (Osbeck) Hale & Ahti, *Taxon* 35: 133 (1986).

Lichen chinensis Osbeck, *Dagb. Ostindisk resa.*: 221 (1757).

Type: Specimen and pl. 20, fig. 39B, Dillenius, *Hist. Musc.*: 147 (1742) (OXF-lectotypotype).

Lichen perlatus Huds., *Fl. angl.*: 448 (1762), (incl. type of *L. chinensis* Osbeck).

Parmelia perlata (Huds.) Ach., *Meth. Lich.*: 216 (1803).

Parmotrema perlatum (Huds.) Choisy, *Bull. mens. Soc. linn. Lyon* 21: 174 (1952).

Thallus corticolous, moderately to loosely adnate, membranaceous to coriaceous, pale mineral grey to whitish-grey, 4-15cm in diam. **Lobes** irregular, 3-8mm wide, in part rounded and deeply crenate, in part irregularly incised and lacinate, imbricate, sparingly to moderately ciliate, cilia 0.2-3.0mm long, \pm branched. **Upper surface** dull, smooth, sorediate; **soralia** submarginal, causing lobe margin to become revolute and suberect, ultimately appearing labriform, soredia granular; medulla white. **Lower surface** black, shining, with a broad, brown, naked marginal zone, moderately rhizinate, rhizines simple, to 2mm long. **Apothecia** very rare, laminal, substipitate, concave, to 7mm in diameter, disc pale brown to cinnamon brown, imperforate, margin thick, inrolled, sorediate; spores ellipsoid, 25-27 \times 16-18 μ m. **Pycnidia** not seen.

Chemistry: Cortex K+ yellow; medulla K+ yellow, C-, P+ orange-red; containing atranorin, chloroatranorin, stictic acid (major), constictic acid (major), cryptostictic acid (trace), menegazziaic acid (trace), norstictic acid (trace).

P. chinense is a cosmopolitan species which is widespread throughout the tropics and temperate areas. In Australasia it is common in Australia and New Zealand, but also occurs in Fiji and Papua New Guinea. It is very rare on Norfolk Island, and although it was the first '*Parmelia*' reported for the island (Endlicher, 1833), this may well have referred to *P. reticulatum*, a morphologically similar and common species.

Specimen Examined:

NORFOLK ISLAND. On treelet stem, S24, *HS* 34830 (US).

Parmotrema crinitum (Ach.) Choisy, *Bull. mens. Soc. linn. Lyon* 21: 175 (1952).

Parmelia crinita Ach., *Syn. Lich.*: 196 (1814).

Type: North America, *Muhlenberg* (H-holotype).

Thallus corticolous or saxicolous, coriaceous, adnate, pale mineral grey to grey-green, 5-6cm in diameter. **Lobes** subirregular, crenate or irregularly incised, imbricate, 2-5mm wide, the margin ciliate, cilia simple or branched, 0.5-3.0mm long. **Upper surface** plane, emaculate, smooth to rugose with age, cortex fragile, isidiate; **isidia** laminal and marginal, short-cylindrical at first, \pm becoming coralloid, granulose or occasionally dissolving into soredia, often ciliate at the apices; medulla white. **Lower surface** black, with a narrow brown, naked marginal zone, densely rhizinate, rhizines slender, simple, to 1.0mm long. **Apothecia** and **pycnidia** not seen.

Chemistry: Cortex K+ yellow; medulla K+ yellow, C-, P+ orange; containing atranorin, chloroatranorin, stictic acid (major), constictic acid (minor), cryptostictic acid (trace), norstictic acid (trace), menegazziaic acid (\pm trace), connorstictic acid (\pm trace).

P. crinitum is a cosmopolitan species, widespread in humid habitats in temperate and tropical regions. In Australasia this species is common in Australia, New Zealand and Papua New Guinea. Common in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On base of *Araucaria heterophylla*, S1, JAE 18133; on base of *Araucaria heterophylla*, S4, JAE 18216, 18246, 18323, HS 31821 (US); on tree and dead branches, S5, JAE 18276, 18293; on *Araucaria* stem, S6, HS 32018 (US); on *Elaeodendron* S7, JAE 18384; on *Lagunaria*, S8, HS 32181 *pr. p.*; on *Campsis grandiflora*, S9, JAE 18469; on base of *Araucaria heterophylla*, S11, JAE 18513; on *Citrus limon*, S12, JAE 18579, 18581, 18588, 18590; on treelet stem, S12, HS 34376; on palm and *Citrus limon*, S14, JAE 18670, 18679, 18692, HS 34515; on volcanic rocks, S17, JAE 18749; on volcanic rocks, S20, JAE 19268; on *Citrus limon*, S24, JAE 18812, 18817.

Parmotrema cristiferum (Taylor) Hale, *Phytologia* 28: 335 (1974).

Parmelia cristifera Taylor, *Hooker's Lond. J. Bot.* 6: 165 (1847).

Type: Calcutta, Wallich (FH-lectotype; BM-isolotypes).

Thallus corticolous, adnate to loosely adnate, coriaceous, pale mineral grey, 3-10cm in diam. **Lobes** irregular, 5-20mm wide, rotund at the apices, entire or weakly crenate, imbricate or subascending at the margins, main lobes eciliate, lateral lobes and lobe axils not or sparingly ciliate, cilia 0.5-1.5mm long. **Upper surface** dull, emaculate, continuous, sorediate; **soralia** mainly marginal on lateral lobes, sorediate lobes more or less ascending, soredia granular; medulla white. **Lower surface** smooth, shiny, black, with a broad, brown, naked marginal zone, sparsely rhizinate, rhizines simple, short, *ca* 0.1-0.2mm long, coarse. **Apothecia** very rare, laminal, adnate, concave, to 3mm in diameter, disc brown, imperforate, margin thick; spores ellipsoid, 25-30 x 13-15µm. **Pycnidia** not seen.

Chemistry: Cortex K+ yellow; medulla K+ yellow then dark red, C-, P+ orange-red; containing atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (± minor).

P. cristiferum is a cosmopolitan species that is widespread throughout tropical and sub-tropical areas. In Australasia and Oceania it is common in Australia, Fiji, Papua New Guinea, Pitcairn Island, Raratonga and New Zealand. Common in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On base of *Araucaria heterophylla*, S1, JAE 18138; on dead branches and shrubs, S5, JAE 18279, 18282, 18301, HS 31908; on *Elaeodendron* stem, S7, HS 32061; on *Elaeodendron*, S8, JAE 18420, 18427; on *Elaeodendron*, S9, JAE 18444; on *Citrus limon*, S12, JAE 18581, 18588, 18590, HS 34264 (B, H, US); on dead treelet stem, S13, HS 34397, 34414 (US); on palm, S14, JAE 18692; on treelet stem and stump, S14, HS 34513, 34516; on crown of *Araucaria*, S15, HS 34596; on *Elaeodendron*, S16, JAE 18735 (*Lich. Australasici Exsicc.* Fasc. 4: 88); on palm stem and dead tree, S16, HS 34633, 34674, 34675 (US); on *Citrus limon*, S24, JAE 18812.

Parmotrema gardneri (Dodge) Sérusiaux, *Bryologist* 87: 5 (1984).

Parmelia gardneri Dodge, *Ann. Mo. bot. Gdn.* 46: 179 (1959).

Type: Brazil, Gardner (FH-holotype).

Thallus corticolous, adnate to loosely adnate, coriaceous, pale mineral grey, 4-6cm in diam. **Lobes** irregular, 8-15mm wide, rotund at the apices, imbricate or subascending at the margins, crenate, irregularly incised or sublaciniate, eciliate or rarely sparingly ciliate, cilia 0.2-0.5mm long. **Upper surface** dull, emaculate, becoming rugose with age, continuous or ± cracked, sorediate; **soralia** marginal, linear along the margins to subcapitate on somewhat revolute lobes or short marginal laciniae, sometimes spreading submarginally, soredia granular; medulla white. **Lower surface** wrinkled, black, with a

broad, brown, naked marginal zone, sparsely rhizinate, rhizines simple, short, *ca.* 0.1-0.2mm long, slender. **Apothecia** rare, laminal, adnate, concave, to 3mm in diameter, disc dark brown, imperforate, margin thick, eciliate, margin and amphithecium sorediate; soredia ellipsoid, 18-22 x 8-10 μ m. **Pycnidia** rare, punctiform, conidia sublageniform, 6-7 x 1 μ m.

Chemistry: Cortex K+ yellow; medulla K+ pale brown, C-, P+ brick-red; containing atranorin, chloroatranorin, protocetraric acid (major), unknown fatty acids (\pm minor).

The presence of the marginal soralia and medullary protocetraric acid plus the absence of cilia distinguish this from other species of *Parmotrema* on the island. It is a pantropical species known from Africa, Australia, Papua New Guinea and South America. Rare in Norfolk Island.

Specimen Examined:

NORFOLK ISLAND. On *Araucaria* trunk, S1, *JA*E 18156.

Parmotrema rampoddense (Nyl.) Hale, *Phytologia* 28: 338 (1974).

Parmelia rampoddensis Nyl., *Acta Soc. Sci. Fenn.* 26: 7 (1900).

Type: Ramboda, Ceylon, *Almquist* (H-NYL 35555-holotype; S-isotype).

Thallus corticolous, loosely adnate, coriaceous, pale grey to mineral grey, 10-20cm in diam. **Lobes** irregular, 5-20mm wide, rotund at the apices, crenate, ciliate, cilia conspicuous, 3-6mm long, simple or bifurcate. **Upper surface** dull, emaculate, rugulose towards the centre, sorediate; **soralia** mainly marginal, linear, sometimes spreading submarginally, soredia farinose; medulla white, often pigmented orange-red adjacent to the lower cortex. **Lower surface** smooth, shiny, black, with a broad, brown, naked marginal zone, sparsely rhizinate, rhizines simple, to 6.0mm long, slender. **Apothecia** not seen in Norfolk Island material. Hale (1965) reports apothecia 3-10mm in diam., disc imperforate, amphithecium sorediate and spores 10-12 x 6-7 μ m. **Pycnidia** not seen.

Chemistry: Cortex K+ yellow; medulla K-, C-, KC+ red, P-; pigmented lower medulla K+ purple; containing atranorin, chloroatranorin, alectoronic acid (major), α -collatolic acid (major or minor), skyrin (\pm).

P. rampoddense is a common and widespread pantropical species. In Australasia it is known from Australia and Papua New Guinea. Rare in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On fallen branch, S5, *JA*E 18125; on treelet stem, S14, *HS* 34532.

Parmotrema reticulatum (Taylor) Choisy, *Bull. mens. Soc. linn. Lyon* 21: 175 (1952).

Parmelia reticulata Taylor, in Mackay, *Fl. Hibern.* 2: 148 (1836).

Type: Ireland, County Kerry, near Dunkerron (FH-holotype).

Thallus corticolous or saxicolous, loosely adnate, membranaceous to coriaceous, pale mineral grey to grey-green, 4-20cm in diam. **Lobes** irregular, 5-15mm wide, in part rounded and deeply crenate, in part irregularly incised and lacinate, imbricate or subscenting at the margins, sparingly to moderately ciliate, cilia 0.2-3.0mm long. **Upper surface** dull, reticulately maculate and cracked, sorediate; **soralia** marginal, linear along the margins to subcapitate, commonly on short marginal laciniae, sometimes submarginal and punctiform, soredia granular; medulla white. **Lower surface** black, rhizinate or papillate to the margins or with a brown, naked marginal zone, densely rhizinate, rhizines simple or squarrose, to 2mm long, slender. **Apothecia** rare, submarginal to laminal, substipitate, concave, to 8mm in diameter, disc pale to mid-brown, imperforate or narrowly perforate, margin thick, eciliate, margin and amphithecium sorediate; spores ellipsoid, 13-18 x 8-11 μ m. **Pycnidia** rare, punctiform, conidia filiform, 12-16 x 1.0-1.5 μ m.

Chemistry: Cortex K+ yellow; medulla K+ yellow then dark red, C-, P+ orange-red; containing atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (\pm minor).

P. reticulatum is a very common and highly variable species. Specimens growing in drier, exposed sites tend to become coriaceous, have weakly developed maculae and often submarginal soralia, while those from moist, shady habitats are usually membranaceous, have marginal soralia and well-developed maculae. *P. reticulatum* is a cosmopolitan species, widespread throughout the tropics and temperate areas. In Australasia it is common in Australia, New Zealand and Papua New Guinea. Very common in Norfolk Island and occasional in Phillip Island.

Specimens Examined:

NORFOLK ISLAND. On *Araucaria* trunk, S1, *HS* 31718, 31723, 31728, 31734 (US); on exposed boulder, S2, *HS* 31748 (H, US); on small rock outcrop, S3, *HS* 31768, 31769 (B, H, US); on *Grevillea robusta*, and *Melia*, S4, *JAE* 18222, 18231, 18250, *HS* 31791, 31839 (US); on dead branch, S5, *JAE* 18308; on rocks, S6, *JAE* 18371, 18374, *HS* 31997, 32022 (US); on old wooden steps, S8, *HS* 32189 (H, US); on *Cyathea* stem, S14, *JAE* 18665, *HS* 34537 (US); on *Araucaria* trunk, S15, *HS* 34578A, 34588 (US); on volcanic rocks, S17, *JAE* 18745, 18746, 18837, *HS* 34695, 34699, 34707 (US); on volcanic rocks, S18, *JAE* 18764, *HS* 34736; on *Lagunaria patersonia* trunk, S19, *JAE* 18778; on volcanic rocks, S20, *JAE* 18833 (*Lich. Australasici Exsicc.* Fasc. 4: 89), 18834, 19267, *HS* 34769 (H, US); on shaded rocks, S21, *HS* 34782.

PHILLIP ISLAND. On south-facing volcanic rocks in the open, S10, *JAE* 18502, 18503, *HS* 32204.

Parmotrema sancti-angelii (Lyngé) Hale, *Phytologia* 28: 339 (1974).

Parmelia sancti-angelii Lyngé, *Ark. Bot.* 13: 35 (1914).

Type: Santo Angelo, Rio Grande do Sul, Brazil, 25 January 1893, *G. A. Malmé* (S-lectotype).

Thallus corticolous, adnate to loosely adnate, membranaceous to coriaceous, pale grey to pale grey-green, 3-10cm in diam. **Lobes** irregular, 5-15 mm wide, rotund at the apices, crenate, often deeply divided and with ascending margins, ciliate, cilia slender, 1.0-3.5mm long, simple or bifurcate. **Upper surface** dull, emaculate, wrinkled or rugose towards the centre, sorediate; **soralia** mainly marginal, linear, sometimes spreading submarginally, soredia farinose; medulla white. **Lower surface** smooth, shiny, black, with a broad, brown or mottled, naked marginal zone, densely rhizinate, rhizines simple, elongate, to 2mm long, slender. **Apothecia** not seen in Norfolk Island material. Hale (1965) reports apothecia imperforate, spores 13-18 x 7-10 μ m. **Pycnidia** rare, conidia weakly sublageniform, 6-8 x 1 μ m.

Chemistry: Cortex K+ yellow; medulla K-, C+ pale red, P-; containing atranorin, chloroatranorin, gyrophoric acid (major), lecanoric acid (\pm trace).

P. sancti-angelii is a common and widespread pantropical species. In Australasia it is known from Australia and Papua New Guinea. Rare in Norfolk Island.

Specimen Examined:

NORFOLK ISLAND. On *Elacodendron*, S5, *JAE* 18349.

Parmotrema tinctorum (Despr. ex Nyl.) Hale, *Phytologia* 28: 339 (1974).

Parmelia tinctoria Despr. ex Nyl., *Flora*, Jena 55: 547 (1872).

Type: Canary Islands, *Despréaux* (H-NYL 35365-holotype).

Thallus corticolous or saxicolous, loosely adnate, membranaceous to coriaceous, pale grey to grey-green, 10-30cm in diam. **Lobes** irregular, 10-20mm wide, rotund at the

apices, entire or crenate, eciliate. **Upper surface** shiny, becoming dull towards the centre, emaculate, cortex sometimes cracking and flaking, isidiate; **isidia** sparse to abundant, laminal and eventually marginal, confluent or in scattered groups, brown tipped or concolorous with the thallus, simple or branched, thin and cylindrical or coarse and irregularly inflated, rarely \pm interspersed with lobules; medulla white. **Lower surface** smooth, shiny, black, with a broad, brown, naked marginal zone, sparsely rhizinate, rhizines simple, short, *ca* 0.5-2.0mm long, coarse. **Apothecia** very rare, laminal, substipitate, concave or \pm radially split, to 20mm in diameter, disc dark brown, imperforate or with a small perforation, margin thick, margin and amphithecium isidiate; spores ellipsoid, 13-15 \times 7-8 μ m. **Pycnidia** rare, conidia filiform, 12-16 \times 1.0-1.5 μ m.

Chemistry: Cortex K+ yellow; medulla K-, C+ red, P-; containing atranorin, chloroatranorin, lecanoric acid (major), orsellinic acid (trace).

Parmotrema tinctorum is a cosmopolitan species that is widespread throughout tropical and temperate regions. In Australasia and Oceania it is common in Australia, Fiji, Papua New Guinea, Vanuatu, Samoa and the North Island of New Zealand. Very common in Norfolk Island and Phillip Island.

Specimens Examined:

NORFOLK ISLAND. On base of *Araucaria heterophylla*, S1, JAE 18137, HS 31739 (H, US); on *Grevillea robusta*, S4, JAE 18221; on *Elaeodendron* and dead branches, S5, JAE 18285, 18307, 18350; on *Araucaria* trunk, S6, HS 32017, 32035 (US); on canopy of fallen tree, S8, JAE 18411; on *Elaeodendron*, S8, HS 32164, 32196 (H, US); on *Elaeodendron* and *Citrus limon*, S12, JAE 18558, 18570; on *Araucaria* trunk, S15, HS 34589 (B, MICH, US); on *Elaeodendron*, S16, JAE 18736 (*Lich. Australasici Exsicc.* Fasc. 4: 90); on rock outcrop, S20, HS 34860 (US); on tree trunk, S22, HS 36482 (B, US); on *Citrus limon*, S24, JAE 18816; on tree in open area, Mt Pitt Reserve, R. Goldsack 4, 25.xii.1981 (ANUC).

PHILLIP ISLAND. On south-facing volcanic rocks in the open, S10, JAE 18499, HS 32225 (B, H, US); on *Lagunaria steni*, S10, HS 32213, 32225.

XANTHOPARMELIA Hale

Xanthoparmelia amplexula (Stirton) Elix & Johnston, *Bull. Br. Mus. nat. Hist. (Bot.)* 15: 192 (1986).

Parmelia amplexula Stirton, *Trans Proc. Roy. Soc. Victoria* 17: 69 (1881).

Type: Australia. Near Brisbane, Queensland, *Bailey* 262 (BM-holotype).

Parmelia violascens Stirton, *Trans Proc. New Zeal. Inst.* 32: 77 (1899).

Type: Australia. Grampian Mountains, Victoria, *Sullivan* (BM-holotype).

Thallus foliose, adnate to moderately adnate on rocks, yellow-green or commonly blackening towards the centre as a result of the dark-tipped, dense isidia; subirregularly lobate, 5-10cm in diam. **Lobes** sublinear-elongate, sparingly imbricate or not so, 0.8-2.0 (3.0)mm wide. **Upper surface** opaque, emaculate, with sparse to numerous isidia, isidia cylindrical, simple or branched and coralloid up to 2mm high; medulla white. **Lower surface** pale brown to dark brown, sparsely to moderately rhizinate, the rhizines concolorous with the lower surface, simple, slender. **Apothecia** rare, 1.5-6.0mm in diam.; disc strongly concave to \pm flat at maturity, dark brown, shining; margin thin, persistent, involute at first, isidiate; spores 7-12 \times 5-6 μ m. **Pycnidia** not seen.

Chemistry: Cortex K-; medulla K-, C-, KC+ rose, P-; containing usnic acid, loxodin (minor), norloboridone (major), unknown (trace).

A common and widespread species in Australia (occurring in all States and Territories) and both islands of New Zealand. It also occurs in Lord Howe Island and South Africa. Rare in Norfolk Island.

Specimen Examined:

NORFOLK ISLAND. On treelet stem, S25, *HS 34916A*.

Xanthoparmelia australasica D. Gall., *N.Z. J. Bot.* 18: 531 (1980).

Parmelia australasica (D. Gall.) Filson, *Aust. J. Bot.* 30: 519 (1982).

Type: New Zealand, North Auckland, Karekare Beach, on andesitic conglomerate, 8 October 1977, J. Bartlett (CHR 314047 — holotype; CHR — isotypes).

Thallus foliose, moderately to loosely adnate, yellow-green, 5-12 (-20)cm in diam. **Lobes** irregular, 2.0-3.5 (-5.0)mm wide, often markedly imbricate, secondary lobes similar to the marginal lobes, sometimes building the thallus up into a thick mat, apices subrotund. **Upper surface** smooth, shining at margins, wrinkled and cracked in the centre, emaculate, moderately to densely isidiate; **isidia** laminal, often forming a dense areolate crust, robust, broad, cylindrical, extensively coralloid-branched, to 2.5mm tall; medulla white. **Lower surface** black with a narrow brown, naked, marginal zone, smooth and shining at margins, matt and wrinkled at centre, sparsely rhizinate, rhizines simple, black. **Apothecia** rare, 2-6 (-8)mm in diam., sessile, deeply concave when young, becoming shallowly convex with age, disc smooth, red-brown, margins conspicuously isidiate, exciple wrinkled, shining, becoming isidiate with age; spores 8-11 x 4-6µm. **Pycnidia** not seen.

Chemistry: Cortex K-; medulla K+ yellow then dark red, C-, KC+ red, P+ orange; containing usnic acid, salazinic acid (major) and consalazinic acid, protocetraric acid (± trace), norstictic acid (± trace).

A common and widespread species in Australia, which occurs in all States and Territories. It also is found in both islands of New Zealand, the continental United States and South Africa. Relatively uncommon in Norfolk Island.

Specimens Examined:

NORFOLK ISLAND. On rock in shaded track cutting, S13, *HS 34371A*; on volcanic rocks, S18, *JAE 18765*; on volcanic rocks, S21, *JAE 18788, 18789, 18790, 18794, 18797, HS 34792* (US).

ACKNOWLEDGEMENTS

We thank the Australian National Parks and Wildlife Service for generous financial support for our field work on Norfolk Island, Dr G. A. Jenkins who determined the chemistry of many specimens and Ms Jen Johnston for many constructive suggestions to this manuscript.

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